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DESCRIPTIVE NOTES OF NEW GENERA AND SPECIES FROM THE
LOWER CAMBRIAN OR OLENELLUS ZONE OF NORTH AMERICA.*

BY

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The types of the new genera and species described in this paper are in the collection of the National Museum, and may be identified by the Museum catalogue number given with the description of each species. The illustrations of the species will be published in the Tenth Annual Report of the Director of the U. S. Geological Survey for the year ending June 30, 1889.

CORALS.

It has been an open question for many years whether the forms referred to the genus *Archæocyathus*, Billings, were corals or sponges (see Bull. U. S. Geol. Survey, No. 30, 1886, p. 78-80). Dr. G. J. Hinde has recently reviewed the genera and species,† and concluded that "the *Archæocyathinæ* form a special family of the *Zoantharia sclerodermata*, in some features allied to the group of perforate corals." Although previously inclined to consider the forms under notice sponges, I am now of the opinion that Dr. Hinde is more nearly correct in referring them to the corals.

Protopharetra BORNEMANN.

See Geol. Zeitschr., 1883, p. 274.

Protopharetra sp. ?

This is a form related to *P. polymorpha* Bornemann.‡ It varies in form of growth from round stems to flattened fronds, in which the structure is very irregular. It is an open question if *Spirocyathus atlanticus* is not generically identical with *Protopharetra*.

LOCALITY.—Silver Peak, Nevada.

Nat. Mus. Cat. Invt. Foss., No. 15303.

Spirocyathus HINDE.

See Quart. Jour. Geol. Soc., London, 1889, vol. 35, p. 136.

This genus is proposed to include the original type of the genus *Archæocyathus*, Billings. As the change to another type was made

*Read before the Biological Society of Washington, June 1, 1889.

†Quart. Jour. Geol. Soc., London, vol. 45, 1889, pp. 125-148, pl. 5.

‡Nova Acta Leop. Carol., Deutsche Acad. Naturforscher, vol. 51, pt. 1, 1886.

by Mr. Billings and no good result can now come from urging the use of the name *Archæocyathus*, as originally proposed, it appears best to accept Dr. Hinde's generic name.

Nat. Mus. Cat. Invt. Foss., No. 14688.

***Coscinocyathus* BORNEMANN.**

See Zeitschr. d. deutsch. geol. Gesellsch., 1884, p. 704.

***Coscinocyathus billingsi* Walcott.**

Archæocyathus billingsi Walcott, 1886. See Bull. U. S. Geol. Survey, No. 30, p. 74.

By the subdivision of the genus *Archæocyathus* this species is referred to *Coscinocyathus*.

Nat. Mus. Cat. Invt. Foss., No. 15302.

***Archæocyathus* (A.) *dwighti* sp. nov.**

This species differs from *A. (A.) rensselaericus* in having in the outer wall a double row of pores and then a raised space upon which no pores have been detected. Interior structure unknown.

LOCALITIES.—Troy, N. Y., and near School-house No. 8, Greenwich, Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18352.

***Ethmophyllum meeki* sp. nov.**

This form differs from *E. whitneyi*, with which it is associated, in having stronger radiating septa, numerous dissepiments, and large pores in the outer wall.

LOCALITY.—Silver Peak, Nevada.

Nat. Mus. Cat. Invt. Foss., No. 18358.

TRAILS, BURROWS, AND TRACKS OF ANIMALS.

As far as known to me there are no true *Algæ* found in the rocks of the Lower Cambrian. That such forms existed, there can scarcely be any doubt, but, after a careful study of all the reported species, I think that they can be referred to trails of worms or mollusks with more propriety than to the *Algæ*.

***Planolites* NICHOLSON.**

Planolites Nicholson, 1873. Proc. Roy. Soc. London, p. 289.

***Planolites annularius* sp. nov.**

The cast of a burrowing worm that shows numerous annulations.

LOCALITY.—At the Reynolds Inn locality, of *Olenellus asaphoides*, one mile west of North Greenwich, Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18360.

***Planolites congregatus* BILLINGS.**

Palæophycus congregatus Billings, 1861. Bull. Geol. Survey Canada, p. 2.

This and the following species were referred to the *Algæ* by Mr. Billings. The reference may be correct, but the species impress me as

being the casts of worm-borings; and there is nothing in the specimen to indicate their vegetable origin. This form of cast is found in sandy argillaceous deposits all through the sedimentary rocks.

Type in the Museum of the Geological Survey of Canada.

Planolites incipiens BILLINGS.

Palaeophycus incipiens Billings, 1861. Bull. Geol. Survey Canada, p. 3.

This character of worm-boring is common in the sandy shales near Swanton, and at Parker's Quarry, Georgia, Vermont. It is associated with *Olenellus asaphoides*. It is impossible to determine whether the trails on the slate were made by the same species of animal as that making the trails referred to *P. congregatus*. As the two forms have received specific names they are retained for the present.

Type in the Museum of the Geological Survey of Canada.

Helminthoidichnites FITCH.

Helminthoidichnites Fitch, 1850. Trans. N. Y. State Agric. Soc. for 1849, p. 868. Compare *Nemertites* Nicholson, 1873. Proc. Roy. Soc., London, p. 289.

Helminthoidichnites marinus EMMONS (sp.).

Gordia marina Emmons, 1844. Taconic System, p. 67, pl. 1, fig. 2.—*Idem*, 1846. Agric. N. Y., vol. 1, p. 68, pl. 14, fig. 2.—*Idem*, Hall, 1847. Pal. N. Y., vol. 1, p. 264, pl. 71, figs. 1, 2.

Palaeophycus rectus Fitch, 1850. Trans. N. Y. State Agric. Soc. for 1849, p. 862.

Compare *Fucoides flexuosa* Emmons, 1844. Taconic System, pl. v, fig. 3.

Helminthoidichnites tenuis Fitch, 1850. Trans. N. Y. State Agric. Soc. for 1849, p. 866, figure in text.

Dr. Fitch proposed the genus *Helminthoidichnites* for tracks resembling those of worms, and figured this species as a very narrow trail on an arenaceous shale. I have seen fragments of a similar trail in the arenaceous slates of the *Olenellus* zone, and also in the Upper Cambrian shales of the Grand Cañon of the Colorado, Arizona. Those from the latter locality afford the best illustration, and a figure is given of a small portion of the surface of the arenaceous shale, showing the trail upon it.

This type of boring or trail is very abundant in the purple, green, and dark slates, and in the arenaceous shales of the *Olenellus* zone. Similar trails may have been made by many different species during all the geologic epochs down to the present day.

Nat. Mus. Cat. Invt. Foss., No. 18359.

Cruziana D'ORBIGNY.

Bilobites DeKay, 1823. Am. Lyc. Nat. Hist., New York, vol. 1. pp. 45-49.

Not *Bilobites* Linn., 1775.

Cruziana d'Orbigny, 1842. Voyage d'Amérique Mérid., III.

Rusophycus Hall, 1852. Pal. N. Y., vol. 2, p. 23.

Cruziana sp. ?

A careful examination of a large series of specimens of the trails and burrows referred to *Cruziana*, from a single layer of sandstone, leads

me to consider that they are all of animal origin, and that many of the so-called species were formed by one species of animal. Also, that specific differences in the animals making them would not generally be shown in the casts of the burrows and trails.

In a paper on the genus *Cruziana* and allied forms I will give my reasons for considering them burrows and trails of animals, and not the casts of fucoids.

Kutorgina labradorica var. *swantonensis* var. nov.

A comparison of a series of specimens of *K. labradorica*, from Newfoundland, with a series from near Swanton, Vermont, shows constant differences. The striae on the Swanton shells are finer and more regular, and the valves are less transverse in proportion to the length, and the beak of the ventral valve is less elevated.

FORMATION AND LOCALITY.—Lower Cambrian. East of Swanton and Highgate Springs, Vermont.

Nat. Mus. Cat. Invt. Foss., No. 15329.

Obolella atlantica sp. nov.

This is a small species of *Obolella* that occurs in great abundance in Newfoundland and also (less frequently) at North Attleborough, Massachusetts.* It is of the type of *Obolella crassa*, but differs in the details of the interior surface and the average smaller size.

LOCALITIES.—Manuel's Brook, Topsail and Brigus Heads, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18322.

Camerella minor sp. nov.

Shell small, moderately convex; valves about equal in depth. Ventral valve convex on the umbo, with the beak slightly incurved; cardinal slopes nearly straight from the beak to the rounded sides; the posterior or umbonal third of the valve is usually more or less tumid, a ridge of growth separating it from the anterior portion of the shell. Dorsal valve shorter than the ventral valve; transversely oval, most prominent at the umbo; beak very small and terminating at the cardinal margin.

The casts of the surface show only concentric lines of growth. Usually a marked line or ridge separates the tumid umbonal portion of the shell from the anterior part.

The casts of the interior of the ventral valve have a small pit just in front of the termination of the beak, from which two narrow depressions extend forward and separate off a short, narrow, central ridge

* Bull. Mus. Comp. Zool., Harvard College, vol. 16, 1888; Prelim. Descript. North Attleborough Fossils, p. 27.

and two lateral pointed projections, which extend forward to the line of the base of the central ridge, and are defined, laterally, by sharp, narrow depressions. This form indicates that two lamellæ or plates extended out from the beak on each side of a narrow central depression and then curved outward towards the margin, somewhat as in *Pentamerus*. In one cast two slight ridges extend from the base of the lateral projections a short distance anteriorly. In the interior of the dorsal valve a transverse depression, just in front of the beak, corresponds to a transverse ridge on the interior of the valve.

Owing to the imperfect casts of the interior the generic reference to *Camerella* is tentative.

In company with Prof. William B. Dwight I found this species associated with heads and fragments of a trilobite that is referred to *Olenellus asaphoides*.

FORMATION AND LOCALITY.—Lower Cambrian. In the quartzitic sandstones of Stissing Mountain, near Stissingville, Dutchess County, New York.

Nat. Mus. Cat. Invt. Foss., No. —.

Colecoloides gen. nov.

Shell slender, elongate, cylindrical, straight or slightly curved, apparently thin.

Surface marked by very fine, slightly oblique, longitudinal striæ in the only species known.

In form this shell is like that of *Hyolithellus micans*, but the surface markings are unlike those of either *Hyolithellus*, Billings, or *Coleolus*, Hall.

Colecoloides typicalis sp. nov.

Straight, slender, elongate, cylindrical shells that taper so gradually that the diminution in size is only apparent in long pieces of the tube and then observable only by the closest examination. Shell apparently very thin.

Surface marked by very fine, slightly oblique, longitudinal striæ that are a little irregular in their course, as shown by a strong magnifier. The striæ make one revolution around the tube in a length of sixteen diameters of the tube.

The longest specimen found has a length of 23^{mm} and is about one-half a millimeter in diameter. It is broken off at each extremity.

I do not know of any related species.

FORMATION AND LOCALITY.—Same as *Hyolithes terranovicus*.

Nat. Mus. Cat. Invt. Foss., No. 18326.

Hyolithes terranovicus sp. nov.

Form an elongate subtriangular pyramid, gradually and regularly tapering to an acute extremity. The angle of tapering of the dorsal side is very nearly 15°. Transverse section subtriangular or semi-

elliptical. Dorsal face slightly convex and curving gently from the extremity to the anterior subspatulate portion. Ventral face strongly and regularly convex transversely; the dorsal and ventral faces meet to form the rounded lateral angles of the shell. Aperture oblique, the margin extending on the dorsal side; the peristome of the ventral side is slightly curved backward. Operculum unknown. Shell thick and strong.

Surface of the shell transversely or concentrically striated; on the dorsal surface the striae are faintly defined and on the ventral surface strongly marked and also cancellated by raised lines with finer striae between.

The largest specimen collected has a width of 16^{mm} at the aperture and a length of about 55^{mm} is indicated, the portion preserved being 48^{mm} in length.

I do not know of any identical species, although the surface markings are like those of *Hyolithes nobilis* Barrande.*

The presence of a septum near the extremity of the shell is very distinct in one species where the point is broken off.

FORMATION AND LOCALITY.—Lower Cambrian. This species is found in irregular masses of limestone resting on and among the boulders of gneiss forming the base of the Olenellus zone on Manuel's Brook, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18319.

Hyolithes similis sp. nov.

Form an elongate subtriangular pyramid, gradually and regularly tapering to an acute extremity. The angle of tapering of the dorsal side is about 13°. Transverse section subtriangular. The ventral angle is sharp and the lateral angles rounded. Dorsal face slightly arched longitudinally, transversely nearly flat, except at the sides, where it curves slightly to meet the two planes of the ventral face, which is strongly angular at the center. Aperture oblique; the peristome is indented at the center of the ventral side and arched over the subspatulate extension of the dorsal face. Operculum unknown. Shell comparatively thin.

Surface of the shell marked by transverse or concentric striae that arch forward on the dorsal face. The ventral face is further marked by four raised lines on each side of the central angle, and between the raised lines by very fine longitudinal striae.

The portion preserved of the largest specimen collected has a length of 43^{mm}. When entire it was about 50^{mm} in length; it has a width at the aperture of 13^{mm}, and a depth of 7^{mm}.

In general form this shell is closely related to *H. americanus*. It differs in the strongly marked ventral surface.

FORMATION AND LOCALITY.—Same as *H. terranovicus*.

Nat. Mus. Cat. Invt. Foss., No. 18317.

* Syet. Sil. Boheme, Vol. III, 1867, pl. 13, figs 22-26.

Helenia gen. nov.

Shell an elongate, narrow, flattened, curved tube; transverse section and aperture elliptical. Surface marked by transverse, concentric, imbricating lines of growth.

Helenia bella sp. nov.

Shell an elongate, narrow, flattened, curved tube. The plane of the flattened surfaces is slightly twisted, so as to throw the lateral margins about one-quarter of a turn around and to incline the upper and lower faces nearly 45° at one extremity, as compared with the other. The curvature is nearly semicircular. The cross-section is an elongated ellipse. The form of the aperture of the larger extremity, as indicated by the striae of growth, has the peristome arching forward on one of the flattened sides and curving slightly backward on the opposite side. As far as I am able to determine the shell was open at the smaller end, as in *Dentalium*, or the extremity was decollated in all the specimens collected. I am inclined to think that it was open at both ends, and hence should be referred to the *Dentalidae*.

Surface marked by irregular, transverse or concentric, imbricating lines of growth that vary in number and size on the same specimen and in different specimens.

Helenia bella is provisionally referred to the *Dentalidae* on account of its form and the apparent opening at both extremities.

FORMATION AND LOCALITY.—In a pinkish-colored limestone of Lower Cambrian age, in association with *Hyolithes princeps*, *Olenellus bröggeri*, etc. In a railway cut north of Manuel's Brook, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18324.

Agnostus desideratus sp. nov.

Cephalic shield about as broad as long, broadly rounded in front, sides curving in very slightly towards the posterior margin; posterior margin sloping obliquely inward from the postero lateral angles to the median lobe. A narrow raised rim extends all around the margin except across the base of the glabella or median lobe. The space between the rim and the glabella is slightly convex. Glabella less than two-thirds the length of the head, narrow, subcylindrical, and with a small tubercle on the posterior third. Surface smooth. A pygidium associated with the head on the same piece of rock has a prominent median lobe bordered by a narrow convex space between it and the marginal rim. The median lobe does not show any indication of lateral or transverse furrows. An elongate median tubercle is the only ornament.

This type of *Agnostus* occurs in the Middle Cambrian zone of the Atlantic Basin as *A. parvifrons*, Linnarsson, and *A. brevifrons*, Linnarsson, of Sweden, and *A. tessella*, Matthew, and *A. umbo*, Matthew, of New Brunswick.

FORMATION AND LOCALITY.—In the upper portion of the Lower Cambrian rocks, a short distance northeast of Salem, Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18327.

Agnostus sp. ?

This species is represented by two imperfect heads of the type of *Agnostus fallax* Linnarsson, of the Middle Cambrian of Sweden, or *A. acadicus* Hartt, of New Brunswick. It is found at the same locality with *A. desideratus* and also two miles south-southeast of Granville, in Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18328.

Microdiscus helena sp. nov.

Head convex, bordered all around by a continuous marginal rim that is narrow at the back and sides and broad in front. Three small nodes occur on the anterior lateral portion of the rim, the center one being on the line of the frontal margin of the glabella. Glabella prominent, cylindro-conical, tumid posteriorly; two furrows cross the middle third so as to separate a narrow central lobe, an anterior lobe nearly twice as long as the central lobe, and a tumid posterior lobe that equals the anterior lobe in length. Dorsal furrows strong; the furrow within the margin is broad and well defined all around except at the occipital furrow crossing the glabella, where it is very narrow; it curves backward inside the very narrow rim at this point. Cheeks tumid, and overhanging the outer marginal groove.

The pygidia associated with the heads are strongly convex; the median lobe, at the center, is a little more than one-third of the entire width of the pygidium; it is crossed by five transverse furrows that divide it into five segments, and a short, terminal segment just inside the strongly defined marginal groove; dorsal furrows strong; marginal rim narrow; lateral lobes slightly convex, smooth.

The head of this species is related to that of *M. meeki* and *M. lobatus*. The tumid posterior lobe of the glabella serves to distinguish it from them and also all described species. The associated pygidium differs from that of *M. bella marginatus* in being more convex and in having five instead of nine segments in the median lobe.

FORMATION AND LOCALITY.—Lower Cambrian. In a decomposed limestone, 600 meters west of Manuel's Brook, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18361.

Olenellus HALL.

See Bull. U. S. Geol. Survey, No. 30, 1886, p. 162.

Thinking that *Olenellus* succeeded the genus *Paradoxides* in time, and accepting the interpretation given by Mr. Ford to the embryonic characters of *O. asaphoides*, I argued in favor of the descent of *Ole-*

nellus from *Paradoxides*. It was an error, as the finding of *Olenellus* beneath *Paradoxides* abundantly proves.

The discovery of more perfect specimens of *O. asaphoides* shows that that which I had identified as the facial suture is a raised line in the cast of the interior of the shell that fills a depressed line occupying the position of the suture. I have since found this raised line in many specimens, but in none is there a true suture cutting through the shell, as in *Paradoxides* and most other genera of trilobites.

Subgenus *Mesonacis* WALCOTT.

See Bull. U. S. Geol. Survey, No. 30, 1886, p. 158.

With the discovery of entire specimens of *Olenellus asaphoides*, *O. kjerulfi*, *O. mickwitzia*, and *O. bröggeri*, it appears that *Mesonacis vermontana* is to be grouped with them, and all referred to *Mesonacis* as a subgenus, on account of the peculiar pygidium of *Olenellus thompsoni*, the type of the genus, as compared with that of *O. (Mesonacis) vermontana*, the type of the subgenus *O. (M.) vermontana*.

Olenellus (Mesonacis) asaphoides EMMONS (sp.).

See Bull. U. S. Geol. Survey, No. 30, 1886, p. 168.

The discovery of entire specimens of this species shows that it has eighteen segments in the thorax, and a small, transverse pygidium, of the *Paradoxides* type. On each of the five, short posterior segments of the thorax there is a long, slender spine that projects back over the pygidium. The entire specimens were found at the original locality of the species, near the old Reynolds Inn building, one mile west of North Greenwich, Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18350.

Olenellus (M.) bröggeri WALCOTT.

Olenellus bröggeri WALCOTT, 1888. Name proposed on exhibition of specimens at the International Geological Congress, London. Name used in "Nature," vol. 38, p. 551, 1888.

General form ovate, the length and breadth nearly as 3 to 2 in comparing the length of the entire body with the width of the head. Head broad, semicircular in outline and moderately convex when preserved in the limestone, but very much compressed in the shales. Margin rather broad, but varying in width one-half in different individuals; it is slightly rounded and separated from the frontal limb and cheeks by a shallow groove and narrow, low ridge; posteriorly it terminates in a comparatively short, strong spine. The posterior margin of the head, between the glabella and postero-lateral spine, is broken just within the latter by a deep notch and a short spine that corresponds to the "interocular" spine (Ford) of *Olenellus asaphoides* and the spine at the pleural angles of the posterior margin of the head of *O. kjerulfi*; a low ridge extends from back of the eye, next to the glabella, out to the

spine, much as in *O. kjerulfi*; the spine varies in size and direction, from the young individual, where it is directed backward, to the large adult, in which it extends obliquely outward. The under side of the margin forms a broad "doublure." It is slightly arched downward and narrows towards the postero-lateral angles of the head. A slight, curved indentation occurs at the point of attachment of the hypostoma. It is a very common occurrence to find the "doublure" on the reflected under margin lying free from the other parts of the head, in the shale, and with the hypostoma attached. This fact leads to the conclusion that a suture may pass around nearer the frontal margin in the same manner as Holm describes it in *O. kjerulfi*.*

Glabella clavate, narrow at the base, reaching its greatest width just back of the anterior termination of the eye lobes; it narrows rapidly towards the rather sharply rounded frontal margin. Three pairs of glabellar furrows occur as shallow depressions, the anterior one opposite the point where the eye lobe merges into the frontal lobe of the glabella; the furrows on the opposite side extend in, but do not unite. Occipital furrow shallow and extending back from each side towards the center. Occipital ring narrow at sides and increasing rapidly in width to the center, where it supports a long, strong spine that curves back over the thorax; none of the specimens show the entire spine, but I think it extends back in the adult fully one-half the length of the thorax. Eye lobes crescentiform, narrow, elongate, arching from the base of the anterior lobe of the glabella, into which they merge, back to a line with the occipital furrow and some distance from the glabella; visual surface unknown. The area between the glabella and eye lobe is slightly depressed, a narrow, shallow furrow extending along the inner edge of the eye lobe. The frontal limb and cheeks slope gently to the ridge within the outer margin. No traces of facial sutures observed, although on some of the casts of the inner side of the shell a depressed line in the shell is indicated by a raised line on the cast. This line follows the direction I should theoretically give to the suture. Hypostoma moderately convex, broad in front and narrowing towards the posterior margin.† One specimen is 18^{mm} across the greatest width, and 12^{mm} across the posterior end. The anterior margin shows a rounded, smooth edge that fits into the slight, curved recess of the "doublure" of the head except laterally, where it extends out to meet the side margin of the anterior wings to form a blunt point; back of the anterior wings the margin is raised to form an elevated rim and then curves under; the rim extends around to and across the posterior margin, becoming most prominent at the postero-lateral angles; the marginal rim is separated from the body by a sulcus that disappears on the anterior wings; the posterior groove, in front of the marginal sulcus, is well defined and

*Afttryck vr. Geol. Foren. i Stockholm. Forhandl., Bd. ix, Haft 7, 1887, p. 16.

† The front margin is the point of attachment to the head and the posterior margin, the margin next to the mouth of the animal and facing the posterior margin of the head.

arches backward from side to side, although very shallow at the center, and it leaves a prominent ridge on each side between it and the posterior marginal sulcus; the anterior grooves are short and scarcely more than pits just back of the main body of the hypostoma. This hypostoma differs from that of *O. (M.) kjerulfi* and *O. (M.) asaphoides* in being narrower anteriorly, more elongate, and with a smooth instead of spinose posterior margin.

Thorax with eighteen segments.* Axial lobe convex; the center of each segment bears a short, strong, curved spine, the base of which reaches longitudinally across the segment. Pleural lobes flattened, about three-fifths of the distance from the axial lobe to the outer edge, and then gently curving to the ends of the remaining falcate portion of the pleuræ. The narrow, median pleural grooves extend outward to the beginning of the curvature of the broad falcate extremity of the pleura. Pygidium small, transverse, almost quadrangular in outline.

None of the examples show the details of structure with sufficient clearness to describe them.

The surface of the head and thoracic segments is ornamented with the peculiar, inosculating, fine, raised fretwork that, as far as known, is confined to the genus *Olenellus*.

Dimensions.—*O. bröggeri* and *O. thompsoni* are the two largest species of the genus yet described. Fragments of *O. bröggeri* now before me indicate a length of 24 centimeters. One head has a length of 8 centimeters. A bed of greenish argillaceous shale 6 inches in thickness is almost entirely formed of fragments of large shells.

The associated fauna includes some well-known *Olenellus* fauna species and others not heretofore described. As known now it embraces fourteen genera, twenty-three species, and six varieties.

FORMATION AND LOCALITIES.—Lower Cambrian. The best specimens were secured in a reddish-brown argillaceous shale, in a railroad cut, about 1 mile west of Manuel's Brook Bridge, on Conception Bay, Newfoundland. It was also found in the limestones beneath Topsail Head and on Brigus Head, on the same bay; at the base of the Manuel's Brook section, where it ranges through 80 feet of strata, and in the decomposed limestone 400 yards west of the brook, in a railroad cut. Stratigraphically its position is 300 feet beneath the *Paradoxides* zone in the Manuel's Brook section.

Comparison.—The great occipital spine, small "pleural" spine, broad falcate extension of the pleuræ, and short, transverse pygidium distinguish *O. bröggeri* from *O. kjerulfi* and *O. mickwitzia* of Europe. With the exception of the form of the pleuræ the same characters separate it from *O. asaphoides*, *O. thompsoni*, *O. (M.) vermontana*, and *O. gilberti*. The head of *O. iddingsi* is quite distinct.

* A note made in the field records eighteen segments in the only entire specimen found. Owing to fragile, decomposed rock the pygidium and five segments of this specimen were ground to powder in transporting the large slab which contained it over the rough roads to St. John's.

The species of *Olenellus* found in Shropshire, England, and given the provisional name of *O. callavei* by Prof. Charles Lapworth,* is very closely allied to, if not identical with, *O. bröggeri*.

Nat. Mus. Cat. Invt. Foss., No. 18331.

Avalonia gen. nov.

Avalonia manuelensis sp. nov.

As the types of the genus and species are the same, one description only will be given.

The genus and species are founded on the central portions of the head of a trilobite that differs from any described species known to me in the form of the dorsal and ocular furrows and fixed cheek.

Head, semicircular, moderately convex. Glabella, subquadrangular, slightly convex, sides parallel; three pairs of narrow, shallow furrows divide the glabella into four subequal lobes; the two posterior furrows extend about one-third the distance across the glabella; the anterior pair are very short and indistinct. Occipital ring narrow, transverse, and separated from the glabella by a strong furrow. The dorsal furrows are well-defined grooves, extending from the posterior margin to the frontal rim. Fixed cheeks, broad, very slightly convex; the anterior fourth is separated by a narrow furrow that starts, at a slight deflection, in the glabellar suture, and extends outward and backward to the facial suture, where it passes into what, in many of the trilobites, is the furrow or eye lobe. This furrow or groove occupies the position of the ocular ridge, from the dorsal furrow to the facial suture, in the genus *Ptychoparia*. The extension of the furrow backward joins the one extending from the occipital furrow outward, just inside the posterior margin. Frontal margin of medium width, and separated from the glabella by a strong furrow; posterior rim of head narrow, rounded, and separated from the fixed cheek by a strong furrow that unites at the postero-lateral angle with the furrow on the outer edge of the fixed cheek. The eye lobe is not distinctly shown in any of the specimens. If present it is probably long and narrow, as in the genus *Centroleura*, of Angelin, or *Anopolenus*, of Salter.

Free cheeks unknown. From the form of the fixed cheeks they were evidently long and narrow.

The broad fixed cheek with its furrows on the lateral and posterior margins recalls the cheek of *Anopolenus*, while the quadrangular glabella is that of the genus *Olenoides*. As far as known to me the depressed ocular furrow is peculiar to the genus.

FORMATION AND LOCALITY.—Lower Cambrian. In railway cut, about 600 meters north of Manuel's Brook, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18333.

*Geol. Mag., new ser., Dec. III, vol. 5, 1888, p. 485.

Zacanthoides eatoni sp. nov.

This species differs from *Zacanthoides levis* in having the glabella clavate instead of subcylindrical; also in the more elongate form of the head. Pygidium unknown.

FORMATION OF LOCALITY.—Upper portion of the Otlenellus zone in Washington County, New York.

Nat. Mus. Cat. Invt. Foss., No. 18362.

Solenopleura harveyi sp. nov.

Of this species only the central portions of the head have been found. These belonged to a very large species, as the heads vary in length from 40^{mm} to 45^{mm}.

The glabella is conical, about twice as long as the width, and separated from the slightly rounded occipital ring by a shallow furrow. Two very shallow furrows extend obliquely backward from the dorsal furrow on each side; they scarcely indent the smooth, convex surface of the glabella; an anterior pair of furrows are indicated by a short, shallow depression on a line with the anterior margin of the eye lobe; the glabella is separated from the fixed cheek and frontal limb by a shallow groove on the sides, and in front by the difference in the slope of its surface and that of the frontal limb. Frontal limb broad and gently convex down to the slight depression separating it from the relatively broad, depressed margins; laterally it passes into the broad, smooth, free cheeks. The frontal margin of the eye lobe is at about half-way between the posterior and anterior margins of the head; it is of medium size; a well-defined ocular ridge extends obliquely backward across the fixed cheek from the glabella to the eye lobe. The posterior margin of the head is separated from the main part of the fixed cheek by a broad, shallow groove.

With the material at hand for study the species is provisionally referred to *Solenopleura*.

The specific name is given in honor of Rev. M. Harvey, the author of the best work yet published on Newfoundland, and the enthusiastic helper of every scientific student who visits the colony.

FORMATION AND LOCALITY.—Lower Cambrian. About 600 meters north of Manuel's Brook, Conception Bay, Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18338.

Solenopleura howleyi sp. nov.

A second large species is referred to *Solenopleura*. It is associated with *S. harveyi*, and is much nearer the type of the genus *Solenopleura* than the latter species. It is known only by the central portion of the head and a few segments of the thorax.

The glabella is elongate, conical, convex, and marked by three pairs of shallow furrows that penetrate obliquely backward one third the distance across the glabella; occipital ring rounded and well defined

from the glabella by a deep furrow; a small node occurs at the center; the glabella rises rather abruptly from the broad, slightly convex fixed cheeks and narrow, frontal limb, a shallow, dorsal furrow serving to give it more prominence. The broad, fixed cheeks are crossed by a narrow, ocular ridge that passes obliquely outward and backward from a point on the dorsal furrow opposite the anterior margin of the eye lobe, where it unites with the outer rim of the rather large, prominent eye lobe. Anterior rim of the head of medium width, rounded and separated from the frontal lobe by a narrow, distinct furrow. The posterior rim or margin is more rounded than the anterior, and the furrow defining it is deeper. The short, postero-lateral limb of the fixed cheek slopes abruptly down to its half-truncated margin.

Surface strongly granular or pustulose.

FORMATION AND LOCALITY.—Associated with *Solenopleura ? harveyi*.

The specific name is given in honor of Mr. James P. Howley, geologist of Newfoundland.

Nat. Mus. Cat. Invt. Foss., No. 18336.

SMITHSONIAN INSTITUTION, June 1, 1889.

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